STUART, JOHN M. • MINING

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MINING:

ITS THEORY AND PRACTICE.

BEING A TREATISE DESIGNED FOR THE BENEFIT OF INVESTORS AND OPERATORS IN MINING PROPERTY.

BY

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Illustrations.

Contents.

Introduction.

In placing this work before the public the chief object is to bring to the notice of those not acquainted with the first principles of mining such ideas as may be useful to them, either as regarding a science in which they may take an interest, or for their guidance in a pursuit into which they may enter.

Feeling the great want of any such work, I have endeavored to express my ideas on this subject in a small, condensed, and plain publication. Therefore this work will treat the subject in a simple manner, free from all technical terms which may tend to confuse the reader.

I believe there is no branch of industry which has had less written about it than mining. The general ideas of the public on this subject are very vague. Almost every one knows what a

farm is, and most people have some idea about the cultivation of land and the processes of raising crops, but mention a mine, and your hearer is often at a loss for a proper idea on the subject. The general idea of a mine is that it resembles a potato-patch in which nuggets can be picked up the size of potatoes.

At this time, when the mining interest of the country is so largely and extensively brought under the notice of capital, I regret to say that there are few who seem to have anything like a proper idea of mining, or into what they are putting their money. I hope not only to place mining in such a light as to prevent the investment of capital in property of no actual value, but also to show mining as a legitimate business and a profitable field for investment, which is now being looked into with great interest by the capitalists of the United States.

I hope that this work will be interesting, and also that it will afford reliable information regarding mines in general. I do not intend it to be an elaborate scientific work, or a work to receive comment from scientific men who may differ in

some technical point from my views. I only wish to give ideas of mining derived from long study and actual experience which will be of value to those who are new at the business, or uninformed of its principles. And to miners of experience this work may be of some value in bringing more fully before them the rudiments of the science, which have been overlooked in their eager advance to its more profitable branches.

I shall endeavor to place before my readers that knowledge which I have derived from study and personal operations in mines, during a series of years, and from which I am enabled to speak of the science, not only in its theory, but in its practice. This I offer in a form which I not only hope will be satisfactory to my readers, but also of financial benefit to the great public now seeking investments in mines.

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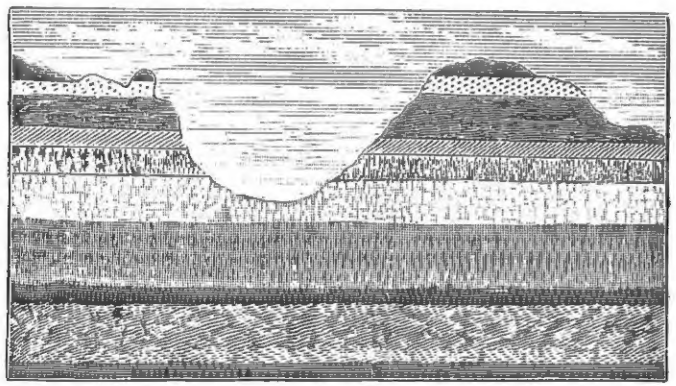
BOREEL BUILDING, *New York.*

Classes of Rocks.

All rocks are divided into two great classes, namely, stratified and unstratified rocks. Stratified rocks are more or less consolidated sediments,



STRATIFIED ROCKS.

and are usually, therefore, more or less earthy in structure. Unstratified rocks have been more or less completely fused, and therefore are crystalline in their structure.

Stratified or Sedimentary Rocks.

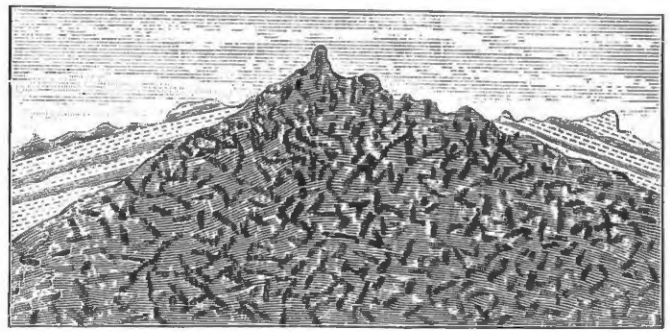
These rocks are characterized by the fact that they are separated by parallel division-planes into long sheet-like masses called strata. About nine tenths of the surface of the land, and no doubt nearly all the sea bottoms, are covered with stratified rocks. Thus it would seem likely that all the surface of the land was at one time covered by water. The thickness of these rocks is certainly not much less than eight miles.

Stratified rocks consist of three varieties—sandrock, lime-rock, and clay—and are more or less consolidated sediments.

Unstratified or Igneous Rocks.

These rocks are distinguished from the stratified by the absence of fossils, and are usually of a crystalline or glassy structure.

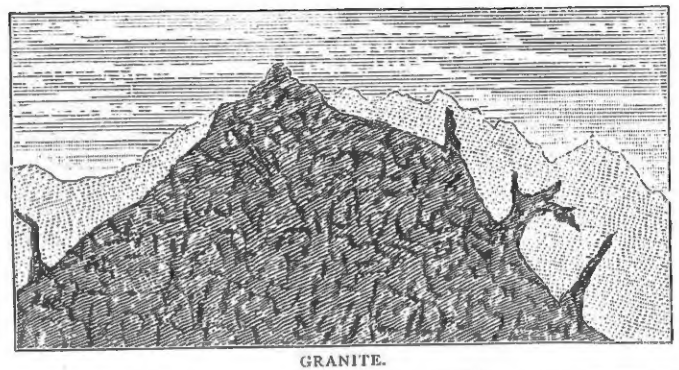
Originally they have evidently been consoli-



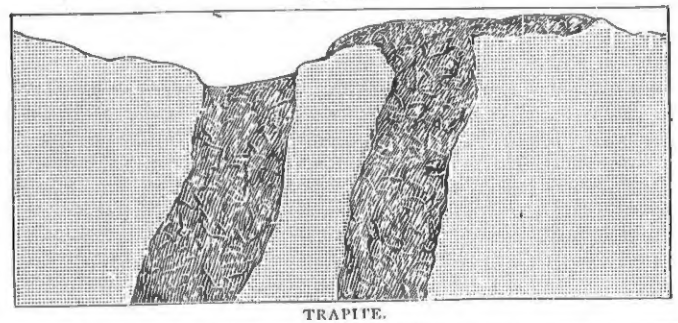
UNSTRATIFIED ROCK.

dated from a semi-fused condition, and are therefore called igneous. They resemble ordinary lava, and their origin is clearly shown by their structure and by the effect they produce by coming in contact with stratified rocks.

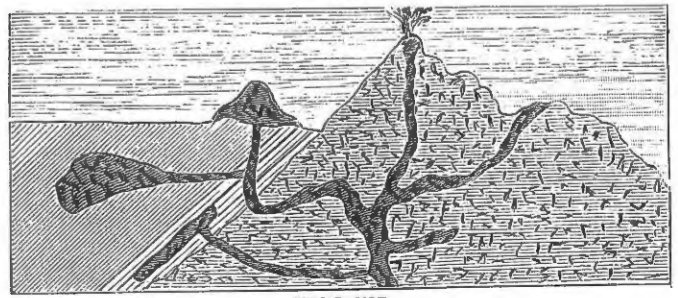
These formations constitute the great mass of



GRANITE.



TRAPITE.



VOLCANIC.

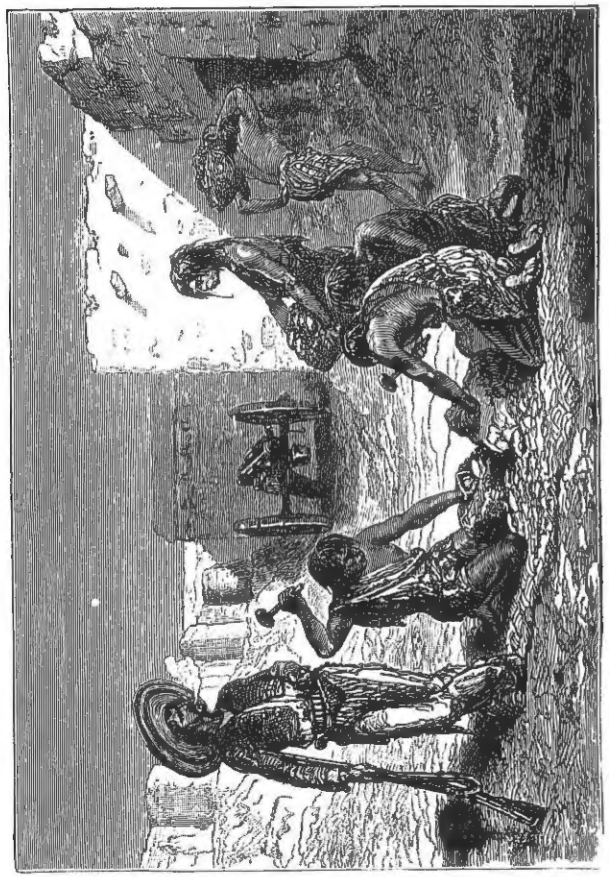
the interior of the earth. They form the peaks of mountain-chains and fill large and extensive fissures throughout sedimentary rocks. They overflow the surface of stratified rocks as if erupted while in a molten condition.

Unstratified rocks are divided into three classes: Granitic, Trapean, and Volcanic rocks.

Granite rocks are cross-grained and of a speckled appearance; they form the peaks of the highest mountains, and appear to have come up through the stratified rocks.

Trapean rocks differ little from Granite, and generally appear in great vertical sheets, or are outspread on the surface, filling large and extensive fissures and forming dykes of vast extent.

Volcanic rocks differ from Trapean in being finer grained and glassy. They have been produced through craters and not fissures—running along as a stream and not overflowing as a fissure. They form isolated deposits and accumulate at points instead of covering a great extent of country.



OLD METHOD OF CRUSHING ORE.

[*From Harper's Magazine.*]

Mines.

Mines of various kinds have been worked from the earliest ages of which we have any record—but these early workings were probably of a very crude and primitive kind. That we read of such immense quantities of precious metals being used in ancient times only indicates, perhaps, that the early seekers after these treasures found them in great abundance and of easy access.

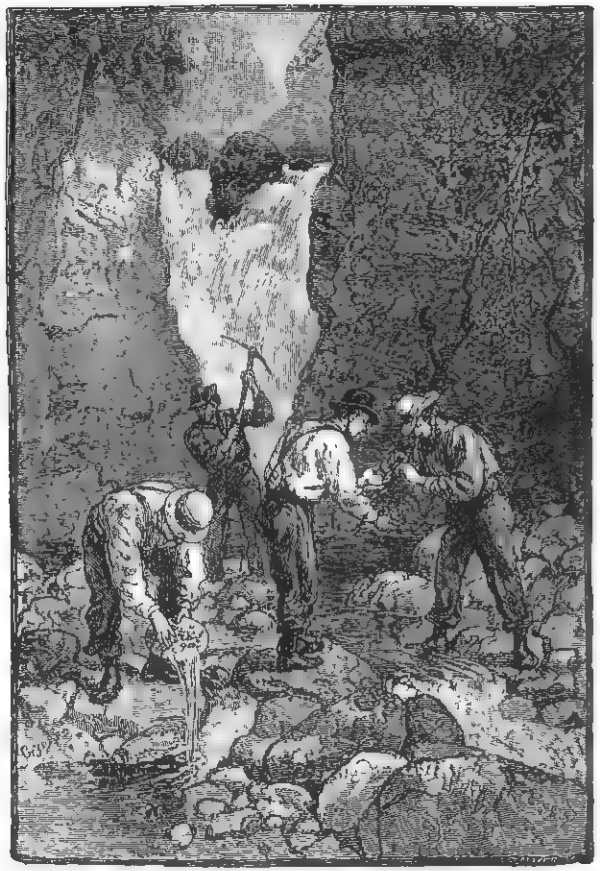
Within the memory of the present generation there have been vast quantities of precious metals added to the circulating mediums of the world, even by the crude processes in vogue in the California of '49 and the best days of gold mining in Australia.

In these days, when science helps in every art and industry, mining has also benefited by her aid, and metals are produced from mines that in earlier days would scarcely have been suspected to exist.

The word *mine* is rather indefinite in regard to its character, general appearance and quality. The term *mine* means a deposit of some kind of mineral either on the surface or below the surface of the ground.

Mines vary in their character, and it is not the name of the mineral that makes a mine valuable. An iron mine may be a far better paying property than a gold mine, and a coal mine may have a greater actual value than a diamond mine. Yet, in a general way, I do not doubt that nine men out of ten would prefer the gold or diamond mine, thinking that they would be of the most value, and not looking to the cost of producing, or the profit obtained from the production.

It is of gold and silver mines that I propose here specially to treat, as now attracting a general and wide-spread interest, and I shall hereafter confine myself to their description.



[*From Harper's Magazine.*]

PLACER MINING.

Placer Gold Mines.

Gold is the most valuable metal in commerce, with a few exceptions, which are little known, and only used for limited purposes in the sciences and arts.

The gold of commerce is obtained from mines of two different characters — one called gulch mines or placer diggings, the other quartz mines.

Gulch mines or alluvial deposits, and a dozen other expressions which indicate the same idea, consist of surface earth mixed with small particles of gold dust, with an occasional nugget or small piece of gold, generally about the size of a pea.

This gold has in ages past been washed from the mountains by streams of water, which have frequently carried it many miles from its source. In time some irregularity has changed the course of the stream and left the washings deposited in a dry bed.

There are instances in which the gold is left far

higher than the course of the stream. Suffice to say that the gold is found mixed through the earth until the bed-rock, as it is generally called, is reached. At this point the gold increases in richness.

The deposit is not as a general thing regular. Thus one claim may be to ground of great value, while the adjoining claim may be of very little or no value whatever. The point is often used as a plea to make sales to parties not well versed in gulch-mining, that because a certain claim sold for a high figure, the adjoining one ought to sell for the same.

We have now come to the point that gold is found mixed with earth or gravel, the richest generally being near the bottom or bed-rock; and that this richness varies.

Placer mines very often have a regular pay streak, which, when followed, yields largely. A mine may have value in it, though if the same be not proved it is not known, therefore the mine will bring but a small price in the market. Property of this sort bought at a low figure often turns out to be valuable when work is done on it;

that is to say, if it shows reasonable appearance to justify the expense of working.

The gold in this vast earth deposit is obtained in many ways by the use of water. The gold pan is the most crude and usual way of testing a gold deposit—which must be indeed rich if it pays when worked by such a method. This is done simply by placing the earth in a common pan and then putting water in the pan and moving it around. The water is then passed off and carries with it small particles of earth. The water is renewed in the pan until all the stones and earth are removed, when a few small particles of gold, varying in size from that of the point of a pin to that of a pin head, may be perceived. These particles are generally termed colors. Thus a miner will say he got three or four colors to the pan. The number of colors and the size of each color determine the paying quality of the mine.

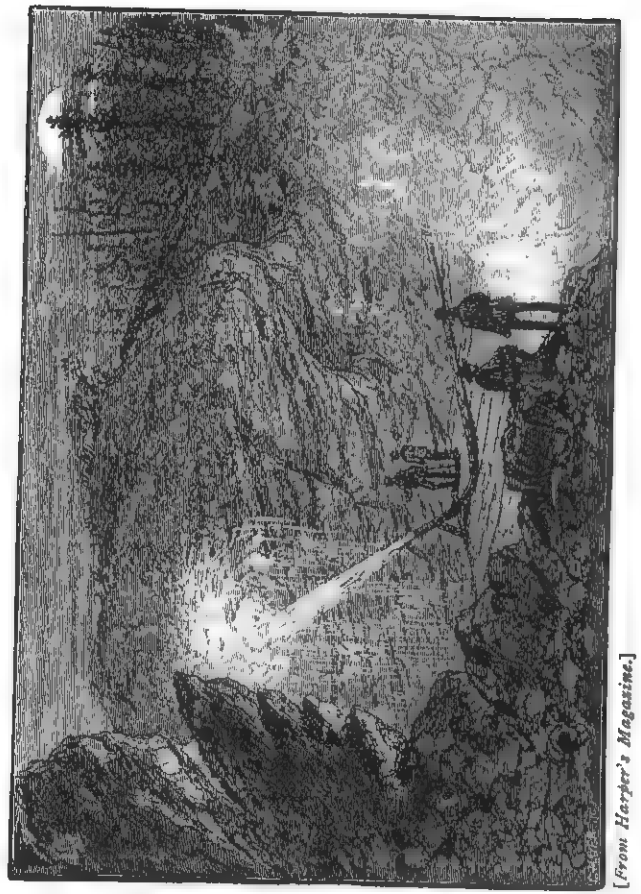
The rocker, of different names and devices, comes next into play as a gold-saving process. Then comes the flume, and in cases where this will not pay, through the limited means of operation, the mines are worked by hydraulics, which

is the only real, genuine and economical way of working large placer claims.

The process consists of bringing a body of water through a hose against the side of an earth-bank containing gold, thus washing down the earth through a flume or trough, constructed of wood, and having slats placed across to save the gold, while the rock and gravel is washed away with great rapidity. The gold is afterward collected from the recesses, in which it has accumulated. The great number of tons of earth which can be worked in this way often enables a mine to pay well which would in any other case be out of the question.

Placer workings are generally done by shafts, which are square holes or wells sunk in the ground, about four by eight feet in size. Upon the surface of the ground is placed a windlass, and by this the rock and earth is raised in buckets. This shaft is sunk until it reaches the bed-rock, when drifts or tunnels are driven in different directions to ascertain the richest part of the diggings.

These mines are also opened, as it is termed, by



HYDRAULIC MINING.

[*From Harper's Magazine.*]

surface workings—washing the ground from the surface until the bed-rock is reached, the water and earth passing through troughs, along which, at intervals of about a foot, are placed small slats of wood, which catch the gold—gold being heavier than the rock is not washed away, although there is a certain loss of gold in small particles which float off with the water.

Such is the general idea of placer mining, and when carried on successfully it is a legitimate business, although there are risks and chances even at the best; and it would not be wise to buy such property, without finding out its paying qualities at the time of the investment. A great part of the gold of commerce has been produced in the above way from the mines of California and Australia.

Fissures.

Our knowledge of the condition under which and the chemical process by which fissures have been filled with mineral matter is yet unfortunately very imperfect. Many various and crude theories have been proposed. Some have supposed that they have been filled as dykes and granite veins by igneous injection. Others that those fissures opening below into the region of heat have been filled by the evaporation of certain minerals in the fissures above. Some suppose that electric currents, such as are known to traverse certain veins, have been the chief agents in accumulating the mineral matter.

Small fissures vary much in their formation from large ones, and it is the general idea that the contents of mineral veins have been deposited from hot solutions coming up through the fissure. Should the vein matter have been deposited by hot solution, then the mineral must have been deposited from the same cause. But in spite of

the works written there are many who have and retain the idea that all veins were formed by volcanic pressure, and in cooling off have left the minerals in their places.

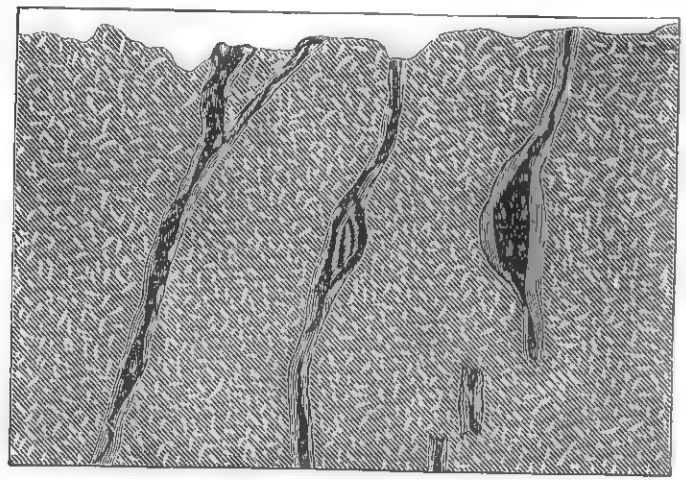
Mineral veins chiefly occur in mountainous regions, with the exception of lead, which is often found in limestone in an undisturbed region. Parallel mineral veins are apt to show a similar ore.

It is often the case in California that the large fissures are crossed by small ones, which no doubt were formed, at the same period, from the large one and filled with the same mineral. A change in the country rock of an outcropping vein is apt to determine some change either in the contents or in the richness of the ore—the general appearance of the country rock is certainly a factor which determines the contents of the vein.

Many veins to a depth of sixty or seventy feet show but poor ore, very often being decomposed, and indicate that the ore has been washed below. Such a vein is likely to turn out well, and in almost all veins there is an outcrop of some kind of low-grade ore.

Although fissure veins are more regular than

other kinds, yet they often vary very much—sometimes branching, sometimes narrowing, or pinching out in some parts and widening in others; sometimes dividing and again coming together, and thus enclosing a portion of the wall rock. Such an enclosed mass of country rock inside a vein is called a "horse." Many of these irregularities are probably the result of movements after the fissure was formed.



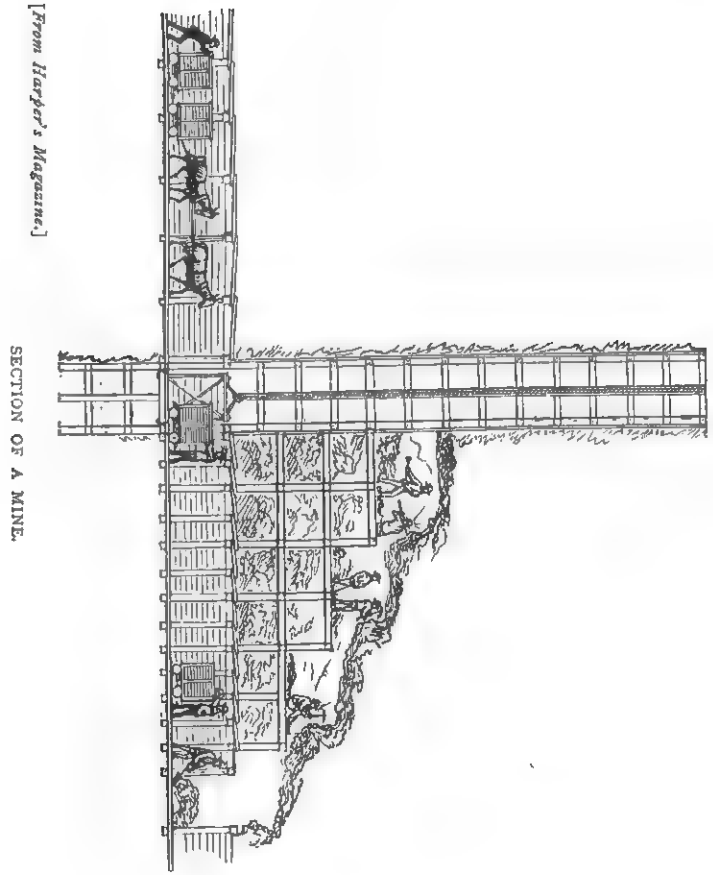
FISSURE VEIN, "HORSE" AND FAULT.

Fissure veins are the fillings of the great fissures produced by the movement of the earth's crust or otherwise. These veins outcrop over the surface of the country for many miles like dykes. They are many feet in width, and extend to unknown depths. The most obvious characteristic of the veins of this class are their size, their continuity for great distances and to great depths, and their occurrence in parallel systems. The distinction between the filling and the wall rock is usually quite marked. In many cases the vein filling is separated from the wall rock by a layer of earthy or clayey matter, called a selvage. The contents of fissure veins are far more varied than those of other classes.

Gold Quartz Mining.

Gold is also obtained from gold-bearing quartz, and a white marble mantelpiece does not give a bad idea of a piece of white gold quartz. I first have to describe a mine, or rather the form of a fissure mine. A gold quartz mine, as it is generally termed, consists of a body of white or other colored material, varying from one foot to two or three hundred feet in width, and showing itself upon the surface—often having the appearance of a stone wall projecting above the general surface. If this vein or wall should be a true fissure, it would extend vertically, or nearly so, to the centre of the earth.

On each side of the quartz there should be a wall. The wall of a mine is simply the rock which joins the quartz on either side of it. It is generally smooth, and has between itself and the quartz a selvage or soft slime paste from one inch to six inches in thickness. This selvage generally extends down with the quartz, and although the



[*From Harper's Magazine.*]

SECTION OF A MINE.

quartz or vein matter may pinch up, yet by following this narrow streak it is sure to come in again. Thus mines with a good regular selvage may be considered more valuable, and are likely to be true fissures if they have distinct walls.

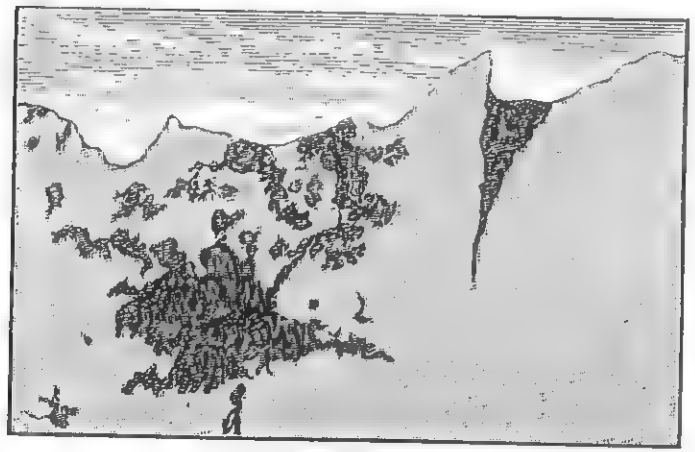
The chief quality of a true fissure is that it is practically inexhaustible, and extends as far as the enterprise of man has taken him. The Comstock may be mentioned as the largest of this variety, although not the most regular.

The great stress generally laid upon a mine being a true fissure is to distinguish it from a gash vein or a deposit.

A gash vein is a vein of quartz, generally of an irregular nature, and making a very large cropping on the surface, which, on extending down, gradually or quickly, as the case may be, pinches or closes up, so that at the depth of a few hundred feet, where it might be expected to find the mine growing valuable, it closes up—or, as a miner would say, "the bottom falls out of it." On such a vein it is not liable to again come in, or not for a great depth.

A deposit is another form of quartz which shows

itself on the surface, and only lies on the surface of some other kind of rock. Thus it is of great importance to know if you have a true fissure, or if the vein you have on the surface will extend as you sink on it—therefore the stress laid on a mine



LIMESTONE DEPOSITS AND GASH VEIN.

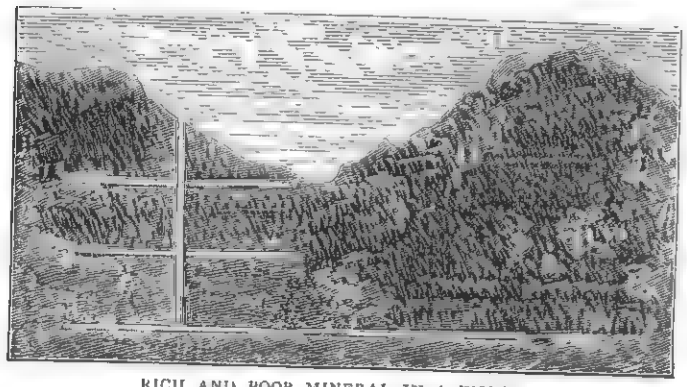
being a true fissure. Although a mine may be a true fissure, yet it may not be better than a mine that is a deposit—in fact, it is very often that different kinds of deposits yield richer mineral and pay better than fissures.

Gold quartz deposits or reefs, as in Australia, are generally more regular in their yield of gold; that is, one piece of rock is more liable to contain about the same percentage of valuable metal as another. They are generally of lower grade, and have to be worked by extensive mills to make them pay. Yet they are often the most reliable and profitable of gold mining operations, as the immense size of the deposit of quartz and the regularity of its mineral allow it to be worked for a small cost, so as to pay handsome returns to its owners.

A gold fissure vein generally shows itself indistinctly on the surface; but this varies in the formation and location where it exists. Yet a blind lode, as it is termed, or one which does not show on the surface, is more likely to have a good gouge or selvage, and to find its walls than a vein which crops out from the surface.

The ore-body in a fissure gold-bearing vein is very irregular, and may be termed pockety; that is to say, a shaft may be sunk at one end of the vein to the depth of one hundred feet and not find any ore—or at least ore which will pay to

work—and one hundred feet from the same spot it may pay immensely; so, because a vein is fifteen hundred feet in length, there is no certainty that it should have pay ore all that distance, unless by sinking shafts at one or two hundred feet apart the same should be proved.



RICH AND POOR MINERAL IN A FISSURE.

The same thing may be said as to the depth of the ore-bodies of a gold mine. A shaft may be sunk on the ore-body in a mine until it reaches the point where it becomes unprofitable; drifts may be then taken each way, and the mineral stoped down till the chamber is exhausted, and

in the meantime, should another rich chamber not have been reached, the value of the mine will have much decreased.

A gold mine generally consists of a series of rich chambers or pockets of greater or less extent and of different shapes and sizes. The first or top chamber generally shows itself upon the surface, and extends down about one hundred feet, at which point there is generally a change. Very often it pinches up, and the vein may have to be followed for a great distance before it again strikes pay mineral.

The chief disadvantage of a gold mine is its uncertainty. Yet as long as it lasts the proceeds are almost fabulous in many cases. This induces capitalists to pay high prices for the property, and after the first chamber is exhausted to spend large sums of money drifting and sinking on the vein in search of pay ore, which often takes from the profit of gold mining. If by systematic and continued work another ore-body or chamber is struck similar to the first, this will generally carry a richer ore and some silver.

The general surface indication and the forma-

tion of the country tell much about the future success and development of mining property, and extensive comparison and particular notice of the way in which the ledges are formed often give the miner and observer ideas which are frequently correct, yet there is nothing more uncertain than the position, size, quality and shape of the pay ore in a quartz ledge.

The character of quartz varies in richness in different localities. The soft quartz, decomposed and honeycombed, often carries its richer ore in a yet softer form of decomposition, while the hard flinty quartz of Peru is impregnated with yet harder rock of rich quality or streaked through with good-sized nuggets of gold.

The treatment of gold quartz is generally done by stamp-mills, which crush the rock to a fine powder, after which it is run through an amalgamating machine, where the gold is collected in quicksilver, which is retorted, the quicksilver collected, again to go through the same process, and the gold saved.

The Arrastra is a very primitive process of working gold ores, and consists of a huge tub, at

the bottom of which are laid large stones to make a floor. Two or three huge stones are fastened to a beam, which is propelled by water or horse power. The ore is thrown in with water and is ground to a fine paste, when the gold is collected. This is an old but successful way of saving gold, and it is being used at the present day in many places where there is a lack of capital.

Gold mining and its reduction may be extended through volumes, but the above will give a short idea of the mine, its working, and the reduction of the metal.

Silver Mines.

Silver has been known to exist from our earliest record, and although we have little authority from where it was produced, or in what manner, yet we know that it did exist and was used as a valuable precious metal from the earliest date. In Peru there exist some of the oldest and deepest mines, which prove that the extreme depth to which silver is found has not yet been reached.

Silver veins and the ore-bodies in them are in general more regular and constant than those of gold. They appear in varied forms, and their mineral is not less varied. Silver appears with lead, copper, zinc, antimony, iron, and various other metals, which are obtained in silver-bearing veins of quartz.

A silver-bearing quartz lode consists of a regular, well-defined vein of hard and brittle quartz rock. In some districts it crops out from the surface rock for forty or fifty feet in height, and can be traced for many miles. This description

of vein is generally a true fissure, although the walls may not be reached till a great depth is attained. The strength of the vein or its size is not a criterion of its paying qualities, yet a mine of this sort can be more relied upon, should it prove to have an ore-body near the surface, than one that is irregular or not continuous.

Ore-bodies in different localities also vary; for instance, on many of the highest mountains the veins are very large and show good pay ore from the surface, which I consider a good indication, as an early paying result is then certain. In other districts not so high, a great depth may be sunk before reaching the pay ore, which makes the mining expensive.

Development.

The development of any mine, no matter what may be its mineral or its nature, is to show to the observation a certain amount of value. Thus, supposing a vein with pay ore of one foot of mineral, then by sinking two shafts of one hundred feet each, and connecting them at the bottom by a drift, it will show a block of mineral which is one hundred feet each way and one foot in width. This is termed ore in sight, for it can actually be seen. Should this ore run one hundred ounces to the cubic foot there would be one million ounces of ore in sight.

For a mine to be really valuable it should be developed, and should show a certain amount of ore in sight; but the greater amount of mines offered to the public have but little development upon them, and therefore ought to have great advantages to justify any large figure paid for them.

Undeveloped property with good prospects, at a low price, may pay well for development, and is almost certain in most cases to prove to be valuable. But, rather than spend money on a worthless mine, or on property which does not show advantages, it would be better to give the money away.

The ore-bodies, as I said before, are far more certain in a silver lode. In fact, in numerous cases, they are almost united the entire length of the vein, although it may vary in richness to a certain degree. The character of the ore-bodies in silver mines often changes—thus at one hundred feet it may show a different variety from that at fifty, and so on—yet they generally show the same general features by which an experienced hand can tell they came from the same mine.

The character of the ore in the vein is apt to indicate in what position the ore will continue. Thus a regular pay streak of galena ore is most likely to continue to a very great depth, and to extend the whole length of the vein.

A vein carrying heavy spar and sulphurets is apt to be pockety, especially should it make its

appearance on the surface in bunches along the vein. A vein of this description, should it be of large extent, would, by sinking and following one of these bunches at a moderate depth—say two hundred feet—come to a large body of ore, although the richness might not equal that of the surface. A large bunch of ore in a heavy quartz vein is a good indication for an extensive ore-body at two hundred feet, and a great likelihood of the mineral increasing rapidly in silver. The body will extend most likely to several hundred feet, but will not reach to the same width.

A vein with copper pyrites, iron pyrites and sulphur mixed through the quartz, if it should be in a large vein, would only bring rich mineral in small splashes, which might not last one or two feet, and which would then again return to the old standard of low-grade ore of the mine.

A blind lode is more apt to show mineral from the surface, and is likely to prove a good mine. The ore is more liable to be of a decomposed nature for at least twenty-five feet from the surface, and to that depth is likely to be richer than below, especially if it carries sulphurets.

In a true fissure, the richest part of the ore-body on the surface is at or near the extreme end, just before the lode enters or re-enters the mountain. If a lode at that point does not show mineral, it is hardly advisable to put much extensive work anywhere else. It is at these two points that the ore-body received the heaviest pressure, and therefore made its greatest effort to protrude through the mountain that resisted it.

At the conjunction of two veins it is a bad policy to sink. The quartz is generally disturbed, there is but little mineral, and that irregular. The heaviest and strongest vein is the one most likely to carry the ore, but fifty feet from the intersection of two veins is generally a good point.

In most veins the ore, especially near the surface, remains on the hanging wall; therefore it is advisable, in cross-cutting a huge vein, to run a drift from the side nearest the hanging wall, so as to cut the ore with as little expense as possible.

Black points, or chimneys, as they are called, having the appearance of being burnt, indicate that an ore-body will be found some one hundred feet on the upward slope of the hill from the chimney.

There are many veins which did not show mineral on the surface, yet by development proved to be valuable mines; but the most frequent thing is that good veins show ore at some point, although it may not have been discovered on the surface in the place it did exist; yet by sinking on some other part the pay ore may be found at a certain depth.

The process of mining is first to prospect and find ore on the surface; the next is to follow it and find more, only removing that which is required for development, so as to show in sight as much ore as possible. This gives both a positive and commercial value to the mine; this development may cost time and money, as the mine is worked. The poor ore can be left, and the rich ore stoped out, and shafts and tunnels driven for the development of new pay ore.

There are many mines which will pay to take out every pound of ore; in such mines the profit of working is much increased. They are generally regular true fissures, carrying heavy galena.

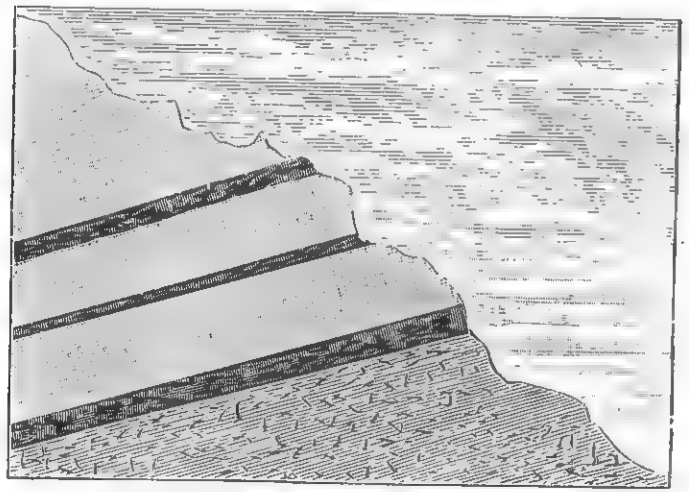
Silver reefs and gash veins are not often found. They are more often under the form of a deposit

of which there are many varieties, varying in the formation in which they are placed.

In a limestone formation, the ore is generally soft and decomposed, very rich, and in small pockets or beds, varying from one foot to one hundred feet wide; the depth also varies. The ore consists chiefly of chlorides and sulphurets. Such properties are rich, but are soon worked out, and it is useless in such formations to sink, expecting to find the ore entered below the limestone ledge. Quartzite deposits, which appear in the breaking off of a formation, or the changing from one formation to another, are generally large and extensive, the ore being of lower grade, and often mixed with galena and quartz, extending in depth until it reaches the change of formation. These are irregular on its surface, and cover a large district Not being all of high enough grade to work profitably, small portions and streaks are mined out and worked. These deposits are very uncertain, and not to be recommended.

Contact Veins.

A regular contact vein is a vein of ore, chiefly of carbonate of lead and iron, which rests between



HORIZONTAL AND REGULAR CONTACT VEINS.

two formations, and to which a limestone foundation seems to be wanted to enable it to be extensive. Thus a contact vein between porphyry

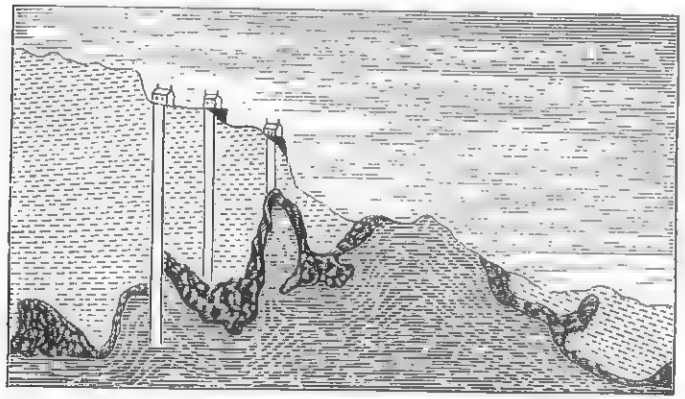
and sandstone, or two different varieties of porphyry, is not as extensive as one which has a foot of limestone.

A contact vein between different varieties of limestone is the most regular, keeping the same width for a great distance. The ore is generally of a low grade in silver. In sandstone and limestone formations, the different stratas of carbonate of lead or pay ore are increased. There is always limestone for a foot, and porphyry above in the largest and the most extensive bodies of ore.

A contact vein may be a fissure ; that is to say, it may be a fissure thrown up between the contact of two formations. The Comstock vein is a contact, to a certain degree, and so is any vein in which the hanging wall varies in its formation from the foot wall.

Irregular contact veins are formed as are those last described, but during the cooling off of the earth's surface have received disturbances which rendered uneven the limestone and allowed the once regular contact to fill into some places and be forced out of others, while a slight upheaval would cause a fault.

So irregular are contacts, in many instances, that they even puzzle the most experienced miners. First, there may be a fine body of rich ore, two feet thick; then, on the same course, it suddenly breaks off to two inches, and then it will



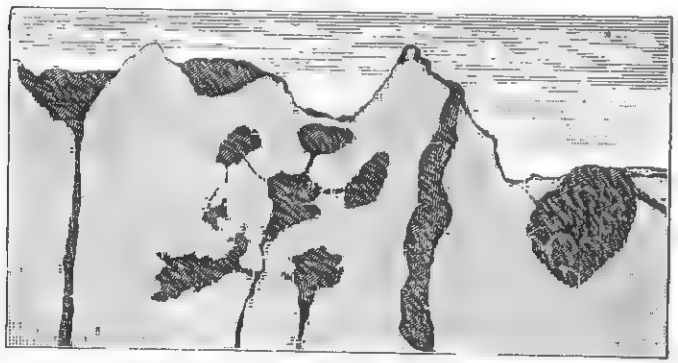
IRREGULAR CONTACT VEIN.

take a dive down, maybe, of thirty feet. Having been carried this far, it may again rise, at an angle of forty-five degrees, increasing as it does, and when the prospects are most encouraging it may come to a fault—the vein is played out, as the term is, and a drift will have to be made in

another direction. This may be more successful; the ore-body may at once jump to forty feet in thickness, and so continue, widening as it goes. In such a case it is not very long before the mine will render a fortune, but while in the height of this success the next claim adjoining may be of little value—the contact as suddenly decreasing, and being too close to allow of any large body of mineral—or, perhaps, the ore-body that is expected to be rich may be poor. Such are the variations of irregular contact veins, which are generally called deposits. In some cases they have had the hanging wall washed from off them, and in others the veins are quite washed from their position. More can be told about the extent of the mineral deposit by the variety of ore which it carries. The ore in these deposits generally consists of carbonates. But it should not be understood, because the term carbonate mine is used, that it should be a deposit or contact. Any fissure vein is liable to carry carbonate ore if the mountains or formation in which it is situated should be loose.

A chimney is a vast body of molten liquid

which reached through the earth's crusts, in formations easily impregnated. In alluvial deposits, or in soft limestone, it appears in the form of horn silver, or in boulders covered with ore, silver blende, etc. It is generally an extensive deposit. It extends as far down as the forma-



CHIMNEYS AND DEPOSITS IN LIMESTONE.

tion may go, and, should the ore be rich enough, the quantity then renders it profitable for working.

In many parts of Europe and South America there are iron deposit ores, which have been forming for centuries and undergoing a natural reduc-

tion work. The ore is generally bog iron ore, and is carried from iron springs either of hot or cold water. The water flowing from the earth has come in contact with silver and iron ore, which it washes off, carrying it to the surface, where, by specific gravity, it is left in the shape of iron deposits. Such ore is low in silver and is often taken for a contact vein especially when the wash has been covered up by earth.

Silver Ores.

Silver ores consist of many varieties which have but little resemblance to each other. The most usual form of ore is argentiferous galena, or silver-bearing lead. Such ore has a bright cast of lead-color, in some cases most brilliant, and the question is often asked if it is pure silver. Its lustre and its weight often make it appear to be valuable when it may be almost worthless.

The other variety is dry ore, such as quartz with gray copper, brittle silver, and fifty other varieties, all giving a tin cast to the metal. The richness of this ore varies much according to what mineral it is associated with. The ores of silver are too numerous to even give a short description of in this work. Suffice it to say the assay value is the only thing an inexperienced man dare go by, and even then, should he not take the mineral from the standing ore in the mine, he is liable to get "salted" ore from

other property resembling in appearance the ore in question.

The usual way for working mines in this country is by shafts and tunnels driven on the vein at about two hundred feet apart. The ore is then stoped out and the mineral taken through the tunnel to the dumps, where it is sorted, sacked, and sent to the mill for reduction to bullion.

Mines require air, and therefore require air-shafts unless air is forced into the mine; but the distance you can advance into a tunnel without air depends upon the looseness of the formation. A tunnel can be driven two thousand feet, in some instances, with the best ventilation, while in another in one of two hundred feet the want of air would be felt. A mine which is above the water-level and can be kept dry by tunnels is preferable to one which has to be kept dry by pumps.

The timbering of a mine is a great point, and should be well looked into. The expense of working is largely increased in a mine that has to be heavily timbered. Timbering consists in supporting the walls and roof of a mine, or in lin-

ing the sides of a shaft. It is done not only to replace the sustaining power of the quartz or other material extracted from the mine, but also in loose formations, to avoid obstructions

A TIMBERED TUNNEL.
[*From Harper's Magazine.*]

in the working parts of the mine arising from the displacement of the surrounding material.

The general mode of reduction of silver ore is by smelting, if it carries enough lead to allow of its being so treated. This is the best and most

advisable mode of treating it. The process consists of first grinding or breaking the ore in a crusher, after the manner of a coffee-grinder; then, of letting it pass through heavy rollers, so as to crush it to a powder. It is then placed in a calcinating or roasting furnace to extract the sulphur from the ore which is refractory in the process of smelting. It is then put into a furnace together with charcoal and iron, and melted down to a liquid, which is moulded into bars of lead and silver and called bullion. The heat of the furnace is intensified by a blower, which forces air into the molten metal after the manner of a bellows.

Other ores besides free milling ores, such as free gold ore, are treated by lixiviation and different forms of amalgamation. By these processes, after the usual grinding and roasting, the ore is converted into metal, which generally runs ninety per cent of the assay value of the ore.

From these works the bullion goes to refiners, who separate the gold, silver, copper, and lead. So the idea of digging up silver expands into a long and tedious process before it becomes the white and beautiful metal we see in use.

Prospecting.

Mines are first discovered by men who call themselves prospectors, and who generally have lived in the West for years. They have a good general view of the business, and traverse the country far and wide with their camp outfit packed on a Mexican donkey, called a burro. Pick in hand, they look for ledges, breaking off particles here and there, which they immediately inspect. Should it show good mineral, they are elated—they have "struck it rich." They are then willing to wait until some man of a little capital shall pass that way and buy. If the vein by their scanty development should prove to be rich, the property is soon sold. If poor, they may hold for many years without a sale.

[*From Harper's Magazine.*]

PROSPECTING.

Mining Investments.

The prospector has the most perfect idea of the value of a mine if he will be frank. The speculator or the storekeeper or man with a few hundred dollars buys an interest in the property from the prospector, and, going East, recommends it to his friends during the winter months, and in many cases negotiates some kind of an arrangement by which they all receive a small sum of cash. The new parties develop the property and prove the value of the mine, generally selling to a company or syndicate of men at a handsome figure. The mine may be then said to be in successful operation—if money can make it so. This is the general outline of mining claims, although there are instances in which the mine is formed into a company by the prospector, but generally it is not developed enough to justify such a proceeding.

In all mining operations there are and must be middlemen, and although it may be said that these men receive great profit for little work, yet

it is often the case that the first party, had he negotiated the property from the prospector, would have either paid twice the price or been put off on some worthless property, and his friend, relying on his judgment, would follow him into an undertaking not likely to succeed.

There are two classes of mining property which are advisable to take—one is undeveloped property with good indications and which should be purchased at a low figure; the other is well-developed property of which there is no question as to its value or the paying quality of the mine Either a company or an individual, to succeed, must acquire one or the other of these properties. No doubt during the next few years large sums of money will be invested in mining operations, and there exists plenty of valuable and good property which will justify the investment of capital without throwing money and time away on property where there is poor chance for success.

It is therefore the duty of all investors in mines, whether in stock or otherwise, to have some idea of the property in which they are interested. Because a mine is undeveloped it is not to be re-

garded as an undesirable investment, but rather the reverse; that is to say, if the property can be got at a low figure while it shows good indications. A mine is simply no more than a farm. A piece of wild land takes years of labor, money, and skill to make it valuable. So it is with a mine; for until it is developed sufficiently to be worked with profit the value is not great. It is not always the property which is stocked and speculated upon in the market that is the most valuable, and it is often that a piece of property of little name may be paying largely.

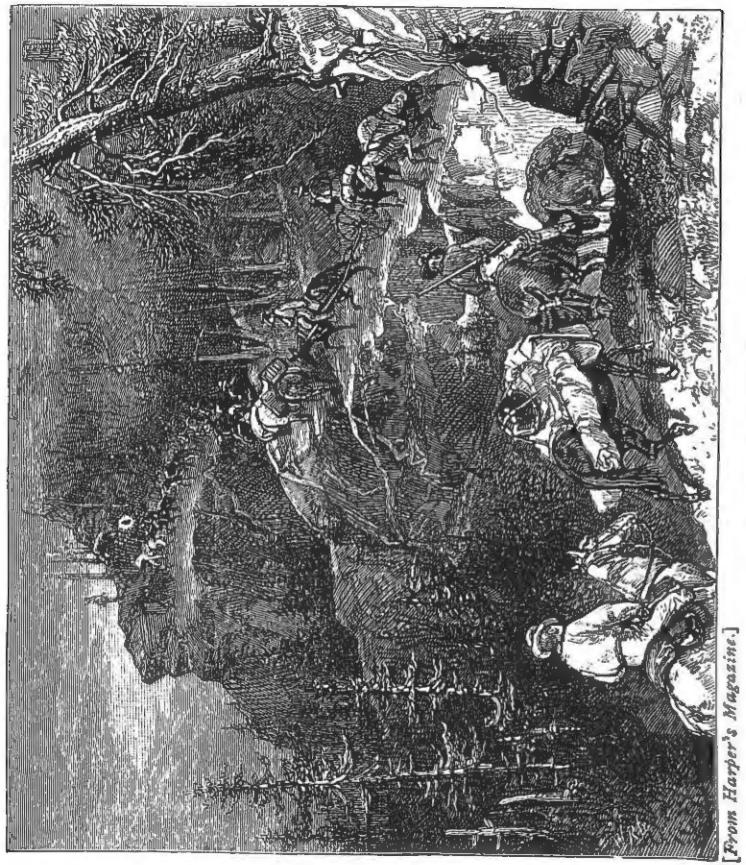
It is hard to estimate the value of a mine, but certainly it is worth one third of the value of the ore in sight—by which estimate no one can go wrong in buying; that is to say, if the ore has paid for working. The district has much to do with the price of a mine.

If one or two paying mines should be found in one place, the rest of the property in that vicinity would at once increase in value; and should more property develop to be good paying mines, other property in adjacent parts, perhaps of no actual value, would, on the strength of what has been

found, rise to a great value, which would, of course, be speculative and perhaps fictitious. So as to the actual paying qualities of a mine, it is often more advisable to invest in parts not so well known and in which there is little or no excitement. It is very often that good mines are near together, yet it is never policy to invest in property simply because it is near some paying mine. Unscrupulous men often sell mines of little value. They would do the same in selling a horse or a farm or anything else. Mining can be carried on the same as farming. A farm can be run in debt—so can a mine. Some farms won't pay, and some mines won't pay. If you want to buy a good farm you must pay for it, and if you wish a good mine you must pay for it. I never saw in any country a good piece of paying mining property which would not sell for some fair figure. You cannot afford to pay as high for a piece of land covered with stumps as for a piece that is in tillable condition; neither can you pay as much for an undeveloped mine as for one which has been proved and opened. It is possible that you may buy property that is developed and yet

not paying, but all these things ought to be found out before the purchase. To put a mine in a good shape for profitable working, it always takes a certain amount of capital, and this every one ought to understand. It takes money to furnish a hotel before you can expect to make any out of it, and it is the same with a mine. But mining, compared with other pursuits, stands out boldly in front, in spite of all that can be said against it. There are many wonderful stories told of mining calculated to mislead the public, therefore I have herein kept from being enthusiastic on the subject. But mining, compared with other business, shows less failure, and in many recognized and standard operations in business more money has been lost than was ever spent in mining. And even compared with steady agriculture, taking the world all over, there are far more risks taken in that pursuit than there need be in mining. Mining is often very profitable, and can be carried on as a legitimate business the same as any other, and from it some of the richest men in the world have derived their wealth.

We must have silver and gold. The world



A MINING DISTRICT.

[From Harper's Magazine.]

cannot exist without it. It is the only thing we can have to describe value. It is useful and ornamental and in demand. It is the great object for which we are all working.

The rough and inaccessible nature of the country in which mining property is generally located has tended much to retard the development of this interest. Agriculture and kindred pursuits in the West have been largely helped by the opening of railroads, and when equal facilities are afforded for access to the mining region and the shipment of its products, mining will start into new life, and its extension can hardly be estimated. But mining, in spite of all these disadvantages, is now coming to the front. Men are tired of real estate, of trade and agriculture, and are looking for something grander, richer, and more extensive. The American people are now turning their ideas to a subject far more important than any other. It is political economy to do so. We all want gold and silver, and now comes the point, how are we to get it? We must have some knowledge of its production, some idea of its working, and the profit derived therefrom.

There are millions of dollars to be made in mining, and it will be the wise, intelligent, and practical men of the present day who will make it. Money well invested in mining will pay well for the investment, but capitalists must look well into the property before they invest, or get men of standing and knowledge to direct and advise them. There are good reliable men who will recommend property and almost guarantee it without having interest therein. A good mine pays better than anything else. It turns out money faster, in proportion to the amount invested, than agriculture, commerce, or trade. It is a grand and interesting business to follow, and worthy to attract and claim the attention of men of the highest standard of ability. It can be carried on as a legitimate business, and can be figured on as closely as any other. It only requires sound judgment, common-sense, and individual or combined capital, and with these mining means advancement, prosperity, and success.

STUART, JOHN M. • MINING